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Anti-Seismic Reinforcement and Expansion Method for Building and Anti-Seismically Reinforced and Expanded Building

BACKGROUND OF THE INVENTION

Technical Field

The present invention relates to an anti-seismic reinforcement and expansion method for building and an anti-seismically reinforced and expanded building. Particularly the present invention relates to an anti-seismic reinforcement and expansion method for building and an anti-seismically reinforced and expanded building where a mid-rise building such as mid-rise staircase type apartment house is expanded and remodeled into a high-rise building with excellent quake-resistance.

Description of the Related Art

In Japan, in 1960s and 1970s, many mid-rise apartment houses were built to meet the increasing demand for housing due to a rapid population growth in suburban areas.

Most of these apartment houses are so-called staircase type apartment houses. These houses have outdoor staircases connecting to the doorways of dwelling units facing each other.

The dwellers in such staircase type apartment houses are generally ageing. These aged dwellers, especially those residing in upper stories, have trouble in going up and down the stairs. Therefore there is a need for remodeling such apartment houses into barrier-free houses that are more comfortable for elderly people.

However, such remodeling causes a lot of problems, for example, vast amount of demolition debris and construction cost. In addition, the dwellers of the apartment houses usually need to move to a temporary address while the apartment houses are remodeled.

In consideration to the above, there is a proposed method for remodeling an existing staircase type apartment house into a balcony type apartment house with passages extending along one side of the building. (See Japan Patent Publication TOKUKAI H11-159153).

The art disclosed therein advantageously enables remodeling of an existing

staircase type apartment house into a balcony type apartment house having newly equipped elevators with the dwellers remaining in the house.

However, this conventional method is not intended to improve quake-resistance. On the other hand, staircase type apartment houses typically have a problem in quake-resistance because these houses were built according to the former Japan national standard for quake-resistance of buildings.

Moreover, it is sometimes desired to increase the dwelling space (the number of dwelling units) in the apartment house upon remodeling the house. However this method cannot satisfy such need.

Accordingly, the object of the present invention is to provide an anti-seismic reinforcement and expansion method for a building that enables remodeling mid-rise buildings, such as staircase type apartment houses, into high-rise buildings that meet the current national standard for quake-resistance of buildings and the buildings remodeled according to the method. This method also allows dwellers to keep living in the house while the apartment house is remodeled.

SUMMARY OF THE INVENTION

The present invention according to claim 1 provides an anti-seismic reinforcement and expansion method for expanding and remodeling an existing mid-rise building (1) into a high-rise building and the method comprising the steps of, providing new seismic isolation foundations (5) for the high-rise building on the outer side of existing foundations of the mid-rise building (1), providing support members (6) on said newly provided seismic isolation foundations, forming new dwelling stories (10) above the existing building utilizing said support members, and after said new dwelling stories are formed, dismantling and removing each story of the above-ground part of the existing mid-rise building with reinforcing existing pile foundations (9).

The present invention according to claim 2 provides an anti-seismic reinforcement and expansion method for expanding and remodeling an existing mid-rise building (1) into a high-rise building wherein said step of reinforcing existing pile foundations is performed by digging around said existing pile foundations and filling concrete (18) around footings (9a) so as to increase the cross sectional area of the footings.

The present invention according to claim 3 provides an anti-seismic

reinforcement and expansion method for expanding and remodeling an existing mid-rise building (1) into a high-rise building and the method comprising the steps of, providing new seismic isolation foundations (5) for the high-rise building on the outer side of the existing foundations of the mid-rise building (1), providing support members (6) on said newly provided seismic isolation foundations, forming new dwelling stories (10) above the existing building with utilizing said support members, after said new dwelling stories are formed, dismantling and removing the above-ground part of said existing mid-rise building to form a space, laying beams (16) in said space to form floors for a second story and stories above the second story are constructed, providing a floor for a first story on the upper portion of existing pile foundations (9), and providing new dwelling spaces on said floors of said each new story.

The present invention according to claim 4 provides an anti-seismic reinforcement and expansion method for expanding and remodeling an existing mid-rise building (1) into a high-rise building and the method comprising the steps of, providing new seismic isolation foundations (5) for a high-rise building on the outer side of existing foundations of the mid-rise building (1), providing support members (6) on said newly provided seismic isolation foundations, forming new dwelling stories (10) above the existing building with utilizing said support members, after said new dwelling stories are formed, dismantling and removing the upper stories of said existing mid-rise building, and remodeling remaining stories of said existing mid-rise building story by story.

The present invention according to claim 5 provides a building anti-seismically reinforced and expanded by the steps of, providing seismic isolation foundations (5) for a high-rise building on the outer side of the foundations of an existing mid-rise building (1), providing support members (6) on said seismic isolation foundations, and forming new dwelling floors (10) above the existing building with utilizing said support members, wherein in said existing mid-rise building, each above-ground stories are remodeled sequentially and existing pile foundations (9) are reinforced.

The present invention according to claim 6 provides a building anti-seismically reinforced and expanded by the steps of, providing seismic isolation foundations (5) for a high-rise building on the outer side of the foundations of an existing mid-rise building (1), providing support members (6) on said seismic isolation foundations, and forming new dwelling stories (10) above the existing building with utilizing said support

members, wherein the second story and stories above the second story are formed by laying beams between said support members in the space created by dismantling and removing the above-ground part of said existing mid-rise building, wherein the first story is provided above existing pile foundations (9), and wherein new dwelling space is formed on the floors of each of the newly formed stories.

The present invention according to claim 7 provides a building anti-seismically reinforced and expanded by the steps of, providing seismic isolation foundations (5) for a high-rise building on the outer side of the foundations of an existing mid-rise building (1), providing support members (6) on said seismic isolation foundations, and forming new dwelling stories (10) above the existing building with utilizing said support members, wherein upper stories of said existing mid-rise building are dismantled and removed and wherein each of remaining stories is remodeled.

BRIEF DESCRIPTION OF THE DRA WINGS

FIG 1 is a schematic view of the longitudinal section of the building remodeled according to the first step of the first embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 2 is a schematic view of the longitudinal section of the building remodeled according to the second step of the first embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 3 is a schematic view of the longitudinal section of the building remodeled according to the third step of the first embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 4 is a schematic view of the longitudinal section of the building remodeled according to the forth step of the first embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 5 is a schematic view of the longitudinal section of the building remodeled according to the fifth step of the first embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 6 is a schematic view of the longitudinal section of the building where existing piles are reinforced according to the first embodiment of the present invention.

FIG 7 is a top view of the building before remodeling according to the method of the present invention.

FIG 8 is a top view of the building in the midterm stage of the anti-seismic and reinforcement method for buildings according to the present invention.

FIG 9 is a top view of the mid-rise building after it is remodeled.

FIG 10 is a schematic view of the longitudinal section of the building in the first stage of the second embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 11 is a schematic view of the longitudinal section of the building in the second stage of the second embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 12 is a schematic view of the longitudinal section of the building in the third stage of the second embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 13 is a schematic view of the longitudinal section of the building in the first stage of the third embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

FIG 14 is a schematic view of the longitudinal section of the building in the second stage of the third embodiment of the anti-seismic reinforcement and expansion method for buildings of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereinafter, preferred embodiments of the anti-seismic reinforcement and expansion method for buildings according to the present invention will be described with reference to the drawings.

The present invention relates to the method for expanding a mid-rise building with three to five stories to a high-rise building with six or more stories. The mid-rise building was constructed according to the former national standard for quake-resistance of buildings before the current law regarding quake-resistance design became ef fective. The high-rise building will meet the current national standard for quake-resistance of buildings which has higher requirement on quake-resistance than the former one. The present invention relates also to a high-rise building constructed using the method of the present invention.

Hereinafter, the present invention will be explained taking staircase type apartment houses as an example of mid-rise buildings. The present invention is

preferably implemented in a staircase type apartment house, though not limited to this.

Figs 1 to 5 is a series of schematic views that shows in sequence the processes of the first embodiment of quake-resistance reinforcement and expansion method according to the present invention.

Fig. 7 shows the building before the method according to the present invention is carried out. Note that Fig. 7 is a top view of the first story (the story at the ground level).

These drawings show the example of a mid-rise building with five stories and a high-rise building with eleven stories. However , the number of stories in the mid-rise building or in the high-rise building is not limited to these.

Fig. 1 and Fig. 7 are views of the mid-rise building (1) shown before being remodeled according to the method of the present invention. The mid-rise building (1) is a staircase type apartment house with outdoor staircases (4) leading to doorways (3) of each dwelling unit (2).

In the first step of the method according to the present invention, seismic isolation foundations (5) for the high-rise building are placed outside the foundations of the existing mid-rise building so that the a series of the new foundations surround the existing mid-rise building (See Fig. 8).

In all the embodiments of the present invention, seismic isolation foundations (5) used for supporting support members (6) can have any known seismic isolation structure. Such seismic isolation foundation (5) can be, for example, a multilayer support which consists of a pair of metal plates disposed on the top and the bottom of the foundation for connection and a lamination support so called as "isolator" disposed between the metal plates. In the lamination support, rubber sheet layers and metal sheet layers are alternatingly laminated. Furthermore viscous fluid can be occluded inside the lamination support for obtaining damping ef fect resulting from the transformation of the fluid.

In order to form new dwelling stories (10), first the support members (6) which work as pillars of the high-rise building are upwardly extending from the top of the seismic isolation foundations (5). Then beams (7) are laid between support members (6) above the existing mid-rise building (1) (See Fig. 2). After that, by setting a roof and floors over the beams, new dwelling stories (10) are formed above the existing mid-rise building (1) (See Fig. 3).

In the embodiment illustrated by the drawings, the newly formed dwelling stories

(10) consists of the sixth story utilized as a shared space (10b) which all dwellers can use and seventh to eleventh stories utilized as dwelling spaces. However, in the present invention, all the floors that are newly formed may be used as dwelling spaces.

After new dwelling stories (10) are formed in such manner, dwellers in the existing mid-rise building (1) move to the newly formed floors (10). Then the existing mid-rise building (1) is remodeled story by story from top to bottom (See Fig. 4).

The lowest story (10b) of the newly formed stories is not used for dwelling purpose, as described above. In this case, this story (10b) prevents the noise caused by the construction in the existing mid-rise building from being transmitted to the newly formed upper stories in which the dwellers moved from the existing building live. The story (10b) may be utilized as a yard for building materials or a field office in order to improve the efficiency of the construction.

By forming new dwelling stories, the dwellers can continuously stay in the building (1) during expansion of the existing mid-rise building (1). In other words, the dwellers need not to move outside the building (1) during the construction.

Therefore, in the present invention, the number of newly formed dwelling stories (10) is preferably larger than the number of stories in the existing mid-rise building (1) so that all the dwellers can move to the newly formed stories.

Each above-ground story of the existing mid-rise building (1) is remodeled by dismantling and removing the outdoor staircases (4) and replacing with new floors (8) extending from the existing floors.

Fig. 9 is a plan view showing the mid-rise building after being remodeled. The existing mid-rise building is remodeled so that the floors are extended in the horizontal direction. After remodeling the existing mid-rise building, in each story of the remodeled existing mid-rise building, a U-shaped aisle (11) is disposed. The U-shaped aisles (11) transversely extends in front of a series of the dwelling units (2) in the story and extends to the outer side of the dwelling units located at both ends of the series of the dwelling units (2). In addition, elevators (12) and emergency stairs (13) are installed on the side of the aisles (11) opposite the dwelling units.

Each entrance (14) for every dwelling unit faces the newly formed aisle (11) so that the dwellers in every dwelling unit can directly access the aisle (11). All the entrances (14) are placed beside the place where the outdoor staircases (4) were originally placed.

Such direct path to the aisle (1 1) serves as an independent escape route for the dwellers in the series of the dwelling units (2) in case of a fire or an earthquake. Furthermore, the dwellers can come in and out their dwelling unit (2) with maintaining their privacy.

Expansion joints are placed between the newly formed aisle (11) and the dwelling units (2) and between the existing dwelling units (2) and the newly extended floor (8). The newly formed aisle (1 1) and the dwelling units (2) are connected with just the expansion unit. This prevents footsteps in the aisles from being transmitted directly to the inside of the rooms. Also the existing dwelling units (2) and the newly extended floor (8) are connected with just the expansion unit. This prevents the vibration of the newly formed part of the house from being transmitted to the existing dwelling space in case of an earthquake. Expansion joints are used in the positions designated by dotted circles in Fig. 9.

The method according to the first embodiment of the present invention features that the existing pile foundations (9) supporting the mid-rise building are reinforced before the above-ground part of the mid-rise building is remodeled according to the above-mentioned method.

During this reinforcement, the existing pile foundations (9) are still embedded in the ground without being pulled out. Also, there is no need to construct new pile foundations. The existing pile foundations (9) are reinforced by digging around and under the existing pile foundations (9) and by filling concrete (18) around and under the footings (9a).

Thus the cross section of the footings (9a) is increased. As a result, the footing (9a) can support higher load and this improves the quake-resistance of the expanded house, especially the part where the mid-rise building (1) originally stood.

In the high-rise building constructed in this way , extended part surrounding the existing mid-rise building (1) is supported by the seismic isolation foundations (5) and the existing mid-rise building (1) by the reinforced foundations (9). Therefore the expanded building becomes a high-rise building with six or more stories that meets new quake-resistance standard, although the building is expanded from a mid-rise building designed according to the former standard.

Figs. 10-12 are schematic views of the longitudinal section of the building expanded and reinforced according to the second embodiment of the present invention

showing in each phase of the construction.

The method according to the second embodiment follows the same initial several processes as the processes of the first embodiment described above. More specifically , the method of the second embodiment also consists of the processes of placing seismic isolation foundations for the high-rise building on the outer side of the foundations of the existing mid-rise building, providing support members on the newly formed seismic isolation foundations, and then forming new dwelling stories above the existing building with utilizing the support members.

Accordingly, the explanation and the drawings relating to these processes common to the first and the second methods will be omitted and only subsequent different processes from the first embodiment will be explained hereinafter.

Referring to Fig. 3, after the new dwelling stories (10) are formed above the existing mid-rise building (1), the above-ground part of the existing mid-rise building (1) is dismantled and removed entirely (Fig. 10).

Around the space generated by dismantling and removing the existing mid-rise building (1), there are support members (6) provided on the seismic isolation foundations (5). Beams (16) are laid on and supported by these support members (6) (See Fig. 11).

Then floor members are placed on the beams (16) to form floors for the second story and stories above the second story. Floors for the first story are formed on the concrete that was cast on the existing pile foundations (9). After forming the floors, dwelling spaces (15) are formed in each story to obtain a high-rise building as shown in Fig. 12.

Such structure allows the newly formed seismic isolation foundations (5) to support the weight load of the second story and the stories above the second story. This decreases the weight loaded on the foundations (9) of the existing mid-rise building (1). Thus, the high-rise building expanded according to the method of the second embodiment meets the new national standard for quake-resistance without reinforcing the existing foundations (9) even though the existing mid-rise building (1) was built according to the former standard.

Figs 13 and 14 are schematic views of the longitudinal section of the building expanded and reinforced according to the method of the third embodiment of the present invention in each process of the construction.

The method of the third embodiment also follows the same initial several steps as

the processes of the first embodiment described above. More specifically , the method of the third embodiment also consists of the processes of placing seismic isolation foundations for the high-rise building outside the foundations of the existing mid-rise building, providing support members on the newly formed seismic isolation foundations, and then forming new dwelling stories above the existing building with utilizing the support members.

Accordingly, the explanation and the drawings relating to these processes common to the first and the second methods will be omitted and only subsequent different processes from the first and the second embodiments will be explained hereinafter.

Referring to Fig. 3, after new dwelling stories (10) are formed above the existing mid-rise building (1), the dwellers in the mid-rise building (1) move to the newly formed dwelling stories (10). Then upper stories of the existing mid-rise building (1) are dismantled and removed (See Fig. 13). The number of the stories dismantled and removed in this process is typically one to three, though not limited to these. In the example shown in the drawings, two stories (the forth story and the fifth story) are dismantled and removed.

By dismantling and removing the upper stories of the existing mid-rise building (1), the weight load on the existing foundation (9) that support the mid-rise building (1) is reduced and the quake-resistance of the high-rise building is improved.

Then the remaining stories (the first to third stories in the example shown in the drawings) of the existing mid-rise building (1) are remodeled and dwelling spaces are formed in each story. Then the construction processes are completed (See Fig. 14).

Each story of the existing mid-rise building is remodeled in basically the same manner as the method of the first embodiment described above in line 6-26 of page 7. More specifically, this remodeling consists of the steps of dismantling and removing the outdoor staircases (4) and forming new floors extending from the existing floors to the space generated by the dismantling and the removing.

In the high-rise building constructed in this way , the extended part surrounding the existing mid-rise building (1) is supported by the seismic isolation foundations (5). On the other hand, the weight loaded on the foundations (9) that support the existing mid-rise building is reduced as the upper stories are removed. Therefore the expanded building, as a whole, becomes a high-rise building with six or more stories that meets new quake-resistance standard, although the building was originally a mid-rise building

designed according to the former standard.

As illustrated in Fig. 14, the high-rise building constructed with the method of the third embodiment has a multi-story hall (17) in the space formerly occupied by the removed stories (the forth and the fifth story in the example shown in the drawings) of the mid-rise building.

According to the anti-seismic reinforcement and expansion method for building and anti-seismically reinforced and expanded building of the present invention, it is possible not only to expand and remodel a mid-rise building such as staircase type apartment house into a high-rise building with the dwellers remaining in the building but also to remodel the existing building designed according to the former standard into a high-rise building that reach the new national standard for quake-resistance.

WHAT IS CLAIMED IS: